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Variation in Coconuts.

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Further to the study of "Variation in Coconuts with particular reference to Fruit Production" as published in the Malayan Agricultural Journal in 1925 (Volume XIII, page 25) the present article aims at bringing that study up to date, since figures are now available for a full seven-year period. In the above-mentioned communication, which dealt with records extending over four years, facts were revealed which clearly showed that variation in fruit production was not only undoubted but was so pronounced that selection work with this commercial crop appeared likely to offer highly remunerative returns.

The records now examined cover a full seven-year period and serve to emphasize the facts previously put forward.

As pointed out in the earlier publication the ten-acre block of land situated on Carey Island from which the records were taken was kindly placed at our disposal by Mr. J. French, the General Manager of Jugra Land & Carey United Estates, and originally carried 480 palms. The land was shown to be of good average productive capacity, flat and well-drained and the palms had been planted 30 x 30 feet apart in September, 1910. The records, which are summarised below, (Table VI) were initiated in June, 1920 when the palms were just 10 years old and have been maintained without a break since that date. They deal with the yields of 473 palms as 2 palms had died and 5 more were young supplies not yet in bearing. At each of the 70 "pickings" the ripe fruits from each palm were cut down by experienced coolies and piled at the base of their respective palms for counting and recording by the writers.

This table shows the group frequencies of the average production per palm per annum over a continuous period of seven years.

TABLE I.

Group.	F.	F × G.	d.	d ²	Fd ²
5	3	15	51	2,601	7,803
15	14	210	41	1,681	23,534
25	30	750	31	961	28,830
35	44	1,540	21	441	19,404
45	76	3,420	11	121	9,196
55	84	4,620	1	1	84
65	91	4,915	9	81	7,171
75	67	5,025	19	351	23,517
85	32	2,720	29	841	26,912
95	24	2,280	39	1,521	36,504
105	5	525	49	2,401	12,005
115	3	345	59	3,481	10,443
N=473		FG=26,365			ΣFd ² =205,403

$\text{Mean} = \frac{\Sigma \text{F.G.}}{N} = \frac{26,365}{473} = 55.74, \text{ say } \underline{56}$	
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$\text{Standard Deviation} = \sqrt{\frac{\Sigma \text{Fd}^2}{N}} = \sqrt{\frac{205,403}{473}} = \sqrt{434} = 20.8.$	
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$\text{Coefficient of Variability} = \frac{\text{S.D.} \times 100}{M} = \frac{20.8 \times 100}{56} = 37 \%$	
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The figures in Table I prove the land to be of good average productive capacity since the average number of fruits obtained per palm per annum is 56 which is usually regarded as a satisfactory figure.

Moreover, the nuts are of good average size since the average yield of copra per acre over the area for the past seven years was 11.17 pikuls (1486 lbs.) and the average number of nuts per acre per annum for the same period was 2,694 so that 241 nuts were sufficient to produce one pikul (133 lbs.) of copra which is considered fairly good.

The coefficient of variability shows that if any palm on the experimental area is picked at random, its average fruit yielding capacity is likely to vary from the mean productive capacity of all the palms in that area by as much as 37% of the mean value. Since the whole area is fairly typical of good average coconut land in Malaya it can be confidently assumed that a similar degree of variation would be found on other profitable coconut areas. This wide and constant range of variation, revealed by the present figures dealing with records over a seven-year period and by the figures previously obtained from records covering periods of two, three and four years, strongly emphasises the economic possibilities of scientific selection of high yielding types. Such a selection involves not only the number of fruits which each palm is capable of producing but due consideration must be given to the average size of the nuts produced by each palm and their copra content; because it is quite conceivable that a palm which normally only produces 70 fruits per annum may yield more copra than a palm of which the average annual fruit production is 90 or 100 or even more.

This fact is exemplified in Table II by comparing palms Nos. 3, 4, 5 and 17. Thus palm No. 3 which produces only 75 fruits per annum, yields more copra than palms Nos. 4, 5 and 17., though these palms produce respectively 92, 94 and 104 nuts per annum. Yet all the palms included in the Table are of the ordinary tall variety.

Table II also shows the variation in copra content of the fruits from twenty-five palms. The variation is expressed in column 4 as a percentage of the mean copra content of all these palms. The range of variation (79% to 131% of the mean) in copra content amongst these palms

which have all been selected as heavy yielders is striking, but for an unselected population of palms the range is still more impressive, since it has been found to extend from 72% to 137% of the mean (from figures of meat content in M.A.J., Vol. 13, 1925, page 305). The copra content (column 3) shown for each palm is the average of numerous determinations as can be seen from column 2. The moisture content (column 5) of the copra derived from each palm is also averaged from the same number of nuts as in the case of the copra and ranges from 5.50% to 10.01% of the weight of the copra. The moisture content was kindly determined by the courtesy of the Chemical Division of the Department of Agriculture.

Columns 7 and 8 portray the calculated yields of copra per palm and per acre, which are derived from columns 3 and 6. While these yields are theoretical and unlikely to be fully attained in practice, still they indicate that a vast improvement is certain to result from selection for heavy yield if properly applied.

TABLE II.

Palm No. E. B.	No. of nuts used in determining columns 3 & 5	Average copra production per nut in grammes.	Variation as a percentage of the mean.	Average moisture content in copra %	Annual fruit production per palm-average of 7 years.	Average copra production per palm per annum in lbs.	Calculated copra production per acre per annum in lbs.
3	15	341	131	8.01	75	57	2,736
4	13	255	98	8.28	92	52	2,496
5	11	211	81	5.68	94	44	2,112
7	12	265	101	7.16	94	55	2,640
8	14	234	90	7.61	87	45	2,160
10	21	236	90	6.01	111	58	2,784
11	38	262	100	8.98	85	49	2,352
12	27	264	101	8.39	108	63	3,024
13	15	206	79	—	158	72	3,456
14	25	270	102	7.68	97	53	2,784
15	17	329	126	8.96	90	66	3,168
15a	17	254	98	8.67	93	52	2,496
17	25	245	94	7.67	104	56	2,688
18	13	255	98	8.78	96	54	2,590
19	16	263	101	9.04	96	56	2,688
20	12	326	126	—	91	66	3,168
22	12	215	82	6.15	94	45	2,160
24	9	243	93	7.29	108	58	2,784
25	15	253	98	6.51	93	52	2,496
26	12	239	92	6.09	113	60	2,880
32	10	240	92	10.01	129	69	3,312
33	10	271	104	5.50	124	75	3,600
37	7	267	102	5.90	137	81	3,888
38	10	302	115	5.70	126	85	4,032
100	10	283	108	—	113	71	3,408

Col 3. Mean = $6,530 \div 25 = 261.2$: say 261 grammes.

Table III is an analysis of Table I and reveals some interesting and instructive figures. The percentages are given to the nearest whole number. If an average annual yield of 40 nuts per palm is considered as the lowest yield on which a coconut plantation can be maintained with a small margin of profit, then 19% of the palms on a plantation are commercially unprofitable from the point of view of copra production. It might be possible, however, to stimulate the producing ability of these palms by special treatment or to utilise them profitably for toddy production.

It is of interest to note that the figures in columns 4 and 5 in Table III afford a comparable parallel to similar figures obtained for rubber crops, (M.A.J., Vol. 13, 1925, page 213) and the fact that 13% of the palms produces almost a quarter of the entire crop clearly indicates that there is ample scope for selection of high yielding palms.

In addition to the figures given in Table III it has been found that 92 palms (or 19.9% of the total population) lie within a group limited by a production of 51 to 61 fruits per palm, these limits representing a group around the mean of production for the total population.

TABLE III.

Groups.	No. of palms.	Yield per palm.	% of total No. of palms.	Yield as % of total crop.
5 to 25	47	30 or less	10	4
5 to 35	91	40 or less	19	10
5 to 45	167	50 or less	35	23
55 to 115	306	50 or over	65	77
65 to 115	222	60 or over	47	60
75 to 115	131	70 or over	28	41
85 to 115	64	80 or over	13	22
95 to 115	32	90 or over	7	12

Table IV is a list of all the palms which produced an average annual yield of only 30 fruits or less over the seven-year period. Since the block of coconuts consisted of 20 parallel rows, each row containing 24 palms (except where young supplies are omitted and where vacancies occur) and since all palms were numbered from the same end of each row, the figures in Table IV show that the poor producing palms were fairly well distributed through the area. Moreover, this table shows that the poor yielders remained poor yielders throughout the period. Rows 1, 10, 11 & 20 were situated beside drains and yet of the 47 poor palms enumerated in the table, 8 palms (or 17%) were in those rows.

If these 47 palms which represent 10% of the total population (or 5 palms per acre) and which only produce a mean of 22 fruits per palm per annum, were replaced by palms producing, say 80 fruits per palm per annum an increase of 1.20 pikuls of copra per acre would be realised, assuming 241 nuts are required to produce 1 pikul of copra.

$$5 (80-22) \div 241 = 5 \times 58 \div 241 = 1.20 \text{ pikuls.}$$

Elaborating this idea to include all the palms on the 10 acre plot which averaged only 40 nuts per annum or less amounting to 91 palms (or 9 palms per acre) (see table III) and having a mean annual yield of only 30 nuts (the actual mean) then the increased production of copra per acre which would accrue by replacing the palms by palms averaging 80 nuts per annum, would be 1.87 pikuls.

$$9 (80-30) \div 241 = 9 \times 50 \div 241 = 1.87 \text{ pikuls.}$$

Table V shows a list of 16 palms which have yielded an average of 95 fruits per annum or over during the last seven years. This table shows that palms producing a high yield of fruits continue to show this character constantly, although of course seasonal variations occur. Again a fair distribution of high yielders through the population is indicated by the palm numbering.

It might be mentioned here that another series of records of individual palm yields embracing a smaller population has been maintained for seven years from Batu Kawan Estate in Province Wellesley, where the variation in annual fruit production per palm ranges from 50 to 158 fruits.

TABLE IV.

Palm No	Total yield of nuts.	Average yield p. a. 7 years.	Palm No.	Total Yield of nuts.	Average yield P. A. N. 7 years.
1/13	133	19	8/16	207	30
1/19	183	26	8/17	200	29
2/3	171	24	8/18	202	29
2/5	136	19	8/24	66	9
2/11	86	12	9/16	203	29
2/18	195	28	10/1	156	22
3/5	97	14	10/8	197	28
3/9	136	19	10/14	178	25
3/11	73	10	10/20	142	20
3/15	122	17	11/5	160	23
4/1	208	30	11/20	184	26
4/23	21	3	12/16	151	22
5/5	183	26	13/11	144	21
5/12	174	25	13/14	151	22
5/15	65	9	14/4	102	15
5/16	148	21	14/5	173	25
5/18	175	25	14/6	111	16
5/19	68	10	14/20	88	13
6/12	208	30	18/16	152	22
6/15	76	11	18, 21	185	26
6/18	177	25	19 1	213	30
7/11	192	27	19/6	190	27
8/1	206	29	19/19	158	23
8/12	209	30	Mean = 22		

TABLE V.

Row No.	Palm No.	Yield.	Row No.	Palm No.	Yield.
5	20	99	12	14	97
6	5	114	13	19	95
6	9	95	14	10	104
9	19	95	15	4	96
10	3	111	15	8	96
11	17	108	15	12	95
12	2	97	16	5	101
12	11	99	17	17	108

Our gratitude is due to the staff of Jugra Land and Carey Limited and in particular to Messrs. French, Melville, Mangin and Nixon for their continued assistance and hospitality without which these records could not have been compiled.

SUMMARY.

- I. The extent of the variability in yield of individual palms over a period of seven years is analysed and discussed.
- II. It is shown that the coefficient of variability in fruit production of an average population of coconut palms is as much as 37% of the mean production.
- III. The variation in copra producing ability of individual palms is found to range from 72% to 137% of the mean in an average population.
- IV. It is stated that 19% of the palms on an average plantation are not profitable.
- V. It is demonstrated that 13% of the palms of an average population produces 22% of the crop.
- VI. It is proven that poor yielders remain poor yielders and that high yielders are constantly high producers.
- VII. The undoubted utility of selecting seednuts from known high copra producing palms is emphasised.

TABLE VI.

Summary of average annual yields per palm over seven years.

Row 1.		Row 2.		Row 3.		Row 4.		Row 5.	
Palm No.	Yield	Palm No.	Yield.	Palm No.	Yield.	Palm No.	Yield.	Palm No.	Yield
1	58	1	54	1	50	1	30	1	63
2	66	2	56	2	38	2	47	2	66
3	76	3	24	3	34	3	38	3	64
4	77	4	70	4	49	4	38	4	66
5	92	5	20	5	14	5	66	5	26
6	79	6	70	6	46	6	38	6	83
7	55	7	37	7	57	7	65	7	37
8	69	8	81	8	49	8	57	8	60
9	75	9	70	9	19	9	92	9	56
10	57	10	68	10	41	10	39	10	52
11	60	11	12	11	11	11	42	11	84
12	86	12	68	12	56	12	51	12	25
13	19	13	49	13	86	13	56	13	65
14	51	14	44	14	60	14	48	14	48
15	37	15	37	15	17	15	61	15	9
16	79	16	35	16	35	16	32	16	21
17	52	17	74	17	47	17	59	17	39
18	56	18	28	18	35	18	74	18	25
19	26	19	68	19	85	19	69	19	10
20	52	20	75	20	52	20	75	20	99
21	78	21	68	21	53	21	62	21	77
22	70	22	62	22	56	22	66	22	63
23	90	23	90	23	51	23	—	23	85
24	66	24	45	24	50	24	47	24	42

TABLE VI.—(Contd.)

Row 6.		Row 7.		Row 8.		Row 9.		Row 10.	
Palm No.	Yield	Palm No.	Yield	Palm No.	Yield	Palm No.	Yield	Palm No.	Yield
1	54	1	45	1	29	1	62	1	22
2	36	2	37	2	46	2	49	2	45
3	64	3	55	3	53	3	90	3	111
4	73	4	71	4	68	4	56	4	87
5	114	5	41	5	66	5	83	5	42
6	46	6	66	6	61	6	72	6	74
7	56	7	42	7	46	7	87	7	77
8	49	8	—	8	67	8	79	8	28
9	95	9	75	9	74	9	49	9	81
10	94	10	94	10	66	10	62	10	62
11	67	11	24	11	75	11	62	11	39
12	30	12	66	12	30	12	63	12	70
13	85	13	54	13	32	13	45	13	64
14	52	14	32	14	50	14	69	14	25
15	11	15	33	15	74	15	82	15	71
16	38	16	27	16	30	16	29	16	74
17	44	17	41	17	29	17	43	17	78
18	25	18	58	18	29	18	93	18	61
19	53	19	84	19	38	19	95	19	46
20	47	20	32	20	50	20	55	20	20
21	89	21	75	21	61	21	75	21	66
22	44	22	67	22	56	22	60	22	67
23	54	23	75	23	48	23	46	23	54
24	56	24	71	24	9	24	59	24	49

TABLE VI.—(Contd.)

Row 11.		Row 12.		Row 13.		Row 14.		Row 15.	
Palm No.	Yield.	Palm No.	Yield.	Palm No.	Yield.	Palm No.	Yield.	Palm No.	Yield
1	61	1	74	1	58	1	79	1	52
2	48	2	97	2	90	2	77	2	55
3	71	3	89	3	80	3	56	3	55
4	55	4	44	4	85	4	15	4	96
5	23	5	67	5	38	5	25	5	63
6	92	6	43	6	47	6	68	6	55
7	39	7	80	7	40	7	68	7	56
8	77	8	72	8	31	8	41	8	96
9	79	9	58	9	85	9	70	9	43
10	85	10	54	10	55	10	104	10	48
11	49	11	99	11	21	11	47	11	58
12	77	12	80	12	93	12	56	12	95
13	69	13	48	13	67	13	74	13	34
14	52	14	97	14	20	14	71	14	81
15	89	15	56	15	75	15	32	15	67
16	36	16	22	16	50	16	16	16	41
17	108	17	62	17	32	17	75	17	39
18	97	18	63	18	50	18	47	18	46
19	69	19	51	19	95	19	63	19	61
20	26	20	44	20	66	20	13	20	56
21	86	21	53	21	60	21	66	21	77
22	52	22	59	22	74	22	78	22	76
23	103	23	66	23	38	23	62	23	64
24	54	24	54	24	42	24	65	24	51

TABLE VI.—(Contd.)

Row 16		Row 17		Row 18		Row 19		Row 20	
Palm No.	Yield	Palm No.	Yield.	Palm No.	Yield	Palm No.	Yield	Palm No.	Yield
1	65	1	67	1	52	1	30	1	31
2	61	2	51	2	63	2	80	2	33
3	49	3	74	3	41	3	64	3	53
4	63	4	75	4	53	4	83	4	53
5	101	5	—	5	76	5	53	5	46
6	67	6	77	6	—	6	27	6	95
7	46	7	80	7	76	7	60	7	50
8	31	8	57	8	66	8	42	8	40
9	80	9	47	9	69	9	49	9	49
10	91	10	—	10	—	10	85	10	69
11	69	11	60	11	58	11	72	11	51
12	62	12	50	12	113	12	61	12	54
13	90	13	84	13	72	13	52	13	74
14	94	14	68	14	74	14	79	14	51
15	47	15	64	15	64	15	58	15	57
16	46	16	31	16	12	16	78	16	36
17	79	17	91	17	88	17	63	17	54
18	63	18	108	18	46	18	71	18	73
19	83	19	61	19	49	19	23	19	64
20	49	20	93	20	55	20	92	20	44
21	31	21	63	21	26	21	41	21	47
22	87	22	72	22	62	22	42	22	39
23	69	23	69	23	77	23	64	23	47
24	60	24	59	24	—	24	37	24	35

Jelutong.

C. D. V. GEORGI.

INTRODUCTORY.

An account was given in a previous number of this Journal, Vol. XV, 1927, No. 3, page 65 of an investigation carried out regarding the treatment considered necessary to preserve jelutong during storage and transit.

It was pointed out that there were two types of deterioration, the drying out of the material to a brittle mass and the development of a mould penetrating the material and resulting in the transformation of the interior of a block into a brownish black sticky mass.

The second type has been observed in blocks of crude jelutong prepared in the laboratory when latex is coagulated with acetic acid, and it was thought that the presence of the black mould might be associated with the use of this coagulant.

Several small blocks of jelutong were therefore prepared with different coagulants and stored for a period of 7 months in order to ascertain whether the type of deterioration was related to the coagulant employed.

The question of the storage of jelutong prepared by boiling the acidified latex has also been investigated, especially from the point of view of loss of moisture during storage.

GENERAL CONSIDERATIONS ON DETERIORATION.

The deterioration due to drying out is regarded by the American manufacturers of chewing gum as the more serious of the two types, since it is not possible to utilise brittle material.

This deterioration develops more rapidly than the fungoid type. It is stated that instances have occurred in which consignments of jelutong have been shipped from Singapore apparently in a satisfactory condition and on arrival in New York a considerable proportion of the material is found to have become brittle.

The loss is less serious in the case of fungoid development, since deterioration is not so rapid and the affected portions can be cut out.

It has always been maintained that the liability of jelutong to deteriorate owing to drying out increases with a reduction in the moisture content, which is reasonable, since the moisture content of the brittle material is only approximately 2 per cent.

Jelutong prepared from latex collected locally and coagulated with acetic acid always develops mould on storage, although there is a considerable reduction in the moisture content during this period. The development of this black mould can be prevented by boiling the material with water, thereby removing the soluble serum solids absorbed by the coagulum. These solids consist principally of sugars and other gummy materials, the presence of which substances favours bacterial action.

A series of experiments, described in the article referred to above, showed that jelutong refined by this method could be stored for periods varying from 6 to 9 months without any deterioration, even though at the end of the period the moisture content of the material was less than 2 per cent.

The results of those experiments show that the reduction of the moisture content is not alone responsible for the jelutong becoming brittle.

Since it has been suggested that the boiling process might change the physical condition of the material and render it more resistant to drying out, the jelutong prepared in the present series of experiments was only washed with cold water.

EXPERIMENTAL.

(a) *Coagulation without further treatment of product.*—Duplicate blocks of jelutong of an equivalent dry weight of 65-70 grammes were prepared by coagulating 500 ccs. of latex with the correct amounts of the following coagulants, acetic acid, formic acid, sulphuric acid, potash alum and sodium silicofluoride. After standing for 3 days the coagula were removed, and the excess of serum squeezed out by moulding the material into small blocks, which were shaped with a light

wooden mallet. The blocks were allowed to drain for 2 days and then weighed.

The loss in weight of the blocks was determined from time to time, care being taken not to break the outside surface. After 7 months the blocks were cut in half, the object being to determine the moisture content of one portion in order to estimate the loss of moisture for the whole block during storage, and to subject the remainder to a further test by exposing the cut surface to the air for an additional period.

The results of the examination showed that it was only possible to continue the experiment with the jelutong coagulated with sodium silicofluoride, these blocks showing no signs of deterioration.

The determination of the moisture content of the product in this case showed that during storage the moisture content of a block had been reduced from approximately 60 per cent to 15 per cent, equivalent to a reduction of 75 per cent calculated on the original moisture content.

Although the weights of the remaining blocks had decreased by more than 50 per cent, indicating a considerable reduction in the moisture content, the blocks had been affected internally to such an extent by the development of mould that further experimental work was useless.

According to the amount of deterioration in the material, the list of the remaining coagulants arranged in order of resistance to fungoid development was acetic acid, formic acid, sulphuric acid and potash alum. With the last coagulant the material had been almost completely transformed internally into a brownish black sticky mass.

(b) *Coagulation with further treatment of product.*—Another series of experiments was carried out in triplicate, in which similar quantities of latex were treated with the various coagulants detailed in the first series. In these experiments the material after coagulation was passed between crepeing rollers, the crepe being folded into small blocks, which were warmed by immersion in hot water for a few minutes and shaped to exclude air from entering between the folds. The blocks were allowed to drain for two days and then weighed.

The results of the examination of these blocks after storing for 7 months, together with the moisture contents of

the blocks at the commencement and conclusion of storage, are given in the following table:

Coagulant used.	Moisture Content (per cent.)		Remarks.
	Fresh Material	Material after 7 months	
Sodium Silico- fluoride	30.5	23.0	Satisfactory
Acetic Acid	26.1	19.8	Fairly satisfactory, slight development of mould.
Formic Acid	28.0	21.3	Fairly satisfactory, slight development of mould.
Sulphuric Acid	26.2	16.1	Unsatisfactory, mould penetrated to a considerable extent.
Potash Alum	Not determined		Unsatisfactory, mould development throughout the block.

Although fungoid development, except in the case of coagulation with potash alum, was not so marked in this series of experiments, the only unaffected blocks were those coagulated with sodium silicofluoride.

In the remaining cases the order of resistance to fungoid development in relation to the particular coagulant was the same as in the first series. The development of deterioration due to mould indicates also that only part of the soluble serum solids are removed during the process of crepeing.

It is interesting to note that the moisture content of the material is not reduced to any considerable extent by passing between crepeing rolls, and further this moisture is retained tenaciously. There was a reduction of 38 per cent, calculated on the original amount, in the moisture content of the material when coagulated with sulphuric acid, but with the

other three coagulants the reduction amounted to only 25 per cent approximately.

(c) *Coagulation by alcohol*.—Although coagulation of the latex by alcohol is not economical, it was thought that deterioration due to drying out might be induced or accelerated by employing this method since the alcoholic serum would evaporate rapidly, leaving the product in a dry state. Experiments were therefore carried out in which the product after coagulation of the latex by alcohol was treated as in (a) and (b) series of experiments.

The results showed that, although in both cases the moisture content of the product had been reduced to approximately 1 per cent. after 7 months storage, there was no sign of the material drying out. The product was hard, but regained its plasticity on immersion in hot water.

REMARKS AND CONCLUSIONS.

From the above experiments it appears that jelutong prepared from latex collected in the local Forest Reserves is unlikely to be affected by deterioration due to drying out. The only type of deterioration observed is due to mould development, which can be ascribed to the presence in the latex of sugars and other gummy substances remaining associated with the coagulum.

The extent of this deterioration decreases according to the amount of these organic materials removed, being greatest with the pressed crude coagulum and absent if the material is boiled with water before pressing.

It is of interest to note that blocks of jelutong refined by boiling have now been stored for 14 months without showing any signs of deterioration due to either drying out or fungoid growth, even though the moisture content has been reduced to less than 2 per cent.

The experiments demonstrate clearly the satisfactory nature of sodium silicofluoride as a coagulant and also as a preservative for the crude material. It is unfortunate that the toxic properties of the substance preclude its use.

Although the results of the experiments have been negative as far as deterioration due to drying out is concerned, a further series of experiments is being made with latex collected

from a locality associated with this type of deterioration in order to ascertain whether this is characteristic of the latex from that district, or is due to the addition of some substance either to the latex or to the material at some stage of its preparation.

The possibility of variations in the constituents of the latex due to botanical differences in the trees tapped is not being overlooked, although such an explanation seems remote.

The preparation and marketing of jelutong is not a well developed industry, and among Asiatic producers a large amount of unnecessary secrecy is still observed regarding the composition of both coagulant and the mixture of substances considered necessary for incorporation with the material to preserve it during storage and transit.

It is well known that the addition of small quantities of salts of copper, iron and manganese to Hevea latex before coagulation, or the incorporation of these substances or the caustic alkalies, sodium and potassium hydroxides, with raw rubber cause considerable variations in the properties of the rubber on storage, by inducing tackiness and eventually brittleness of the product.

It appears possible therefore that the contamination of jelutong latex or the coagulum with small quantities of such substances may influence profoundly the properties of the jelutong during storage. Experiments on these lines are being carried out.

PREPARATION OF JELUTONG.

Satisfactory reports of the quality of the jelutong prepared by boiling the acidified latex and then treating the coagulum with boiling water before pressing continue to be received from the American buyers.

The addition of soap emulsion when refining the coagulum appears to be unnecessary, experiments having shown that after 6 months there is no difference either in appearance or texture between the product prepared with soap emulsion or treated only with boiling water.

It has been noticed that the addition of soap emulsion has resulted occasionally in the material becoming sticky and

liable therefore to adhere to the sides of the press. The treatment has therefore been discontinued.

Blocks of material prepared by boiling the acidified latex appear to be less porous than those in which the ordinary method of coagulation has been used. This results in both a diminution of the original moisture content and the loss of moisture during storage.

Two blocks of jelutong, coagulated by the two methods, were refined by boiling with water and then stored for 8 months, the moisture contents of the blocks being determined at the commencement and the end of the period. The condition of both blocks on conclusion of the storage period was satisfactory. The results of analysis are shown in the following table:

Method of Coagulation	Moisture Content (per cent.)		Reduction in Moisture Content (per cent.)
	Fresh Material	Material after 7 months	
Latex coagulated by boiling.	36.4	17.7	51.4
Latex coagulated by standing.	46.3	6.0	85.8

From these results it will be seen that the loss of moisture is considerably less with jelutong coagulated by boiling and, since it is maintained that a reduction in the moisture content is liable to induce deterioration due to drying out, the material prepared by this method is to be preferred.

The method also has the additional advantage that the soluble serum solids responsible for fungoid development are removed in the process, so that the material should be particularly resistant to either type of deterioration.

In conclusion the writer wishes to thank the representatives in Singapore of L. A. Dreyfus & Co., New York, for certain information included in this article.

SUMMARY.

1. This article deals with the problem of deterioration of jelutong and describes certain experiments carried out with the object of inducing one type of deterioration.

2. Details of the loss of moisture on storage from blocks of material prepared by coagulation of the latex by boiling with acetic acid as compared with ordinary method of coagulation are also given.

Received for publication October, 7th 1927.

Notes on Miscellaneous Insects of 1926.

G. H. CORBETT AND CEDRIC DOVER.

Like its predecessor* the present paper is intended to supplement the notes on insects in the Annual Report for 1926.† The exhaustiveness of the previous paper and the publication of a list of foodplants of Malayan insects,‡ naturally limit the scope of the present note to observations on insects which have not been previously mentioned, or which have been found on additional food-plants. The following pages, therefore, though primarily intended for the use of the general reader who is also acquainted with the former publications, will be found to contain a large number of original records. The arrangement of the present paper is similar to that on the Insects of 1925, but an index of plants has been thought unnecessary, and a departure has been made in adding a list of parasites from hitherto unrecorded hosts.

Additional records of Coccids have not been incorporated, as Mr. F. Laing of the British Museum is engaged on a special paper on the Malayan species, based on material supplied by this Department.

FRUIT.

LEPIDOPTERA.

Orgyia horsfieldi Saund.

The caterpillars of this Lymantriid moth have been found on the leaves of *Eugenia aquea*, the fruit of which is known to the Malays as "Jambu ayer". They are of a greenish-brown colour with longitudinal rows of yellow lines. Structurally they are of the usual Lymantriid type: with tufts of long hairs arising from tubercles on the antero-lateral margins of the first segment, four erect tufts of yellow hairs on the first four abdominal segments and bunches of lateral hairs. The pupal period lasts about 10 days.

Prodenia litura Fabr.

This species, which was discussed in the paper on the insects of 1925, has since been recorded on papaya and

* Corbett & Gater: "Miscellaneous Insects of 1925". M.A.J. XIV, p. 242, 1926.

† Corbett: "Annual Report of the Government Entomologist for 1926". M.A.J. XV, p. 168, 1927.

‡ Corbett & Gater: "A Preliminary List of Food-Plants of some Malayan Insects". Bulletin No. 38, Dept. of Agric., S.S. & F.M.S., 1926.

banana, the only fruit trees on which it is so far known to occur in the Malay Peninsula. The specimens on papaya pupated in 9—12 days.

Parallelia palumba Guen.

This is a Noctuid, the caterpillars of which feed on the leaves of the pomelo. The caterpillar is a greyish-green semi-looper with round black lateral spots. The pupal period occupies from 10—13 days.

Nyctalemon patroclus L., *Lyssidia achillaria* Hub. and *Micronia astheniata* Guen.

The caterpillars of these three Uraniid moths have been recorded on the leaves of the "Malay Apple" (*Eugenia malaccensis*), the damage done by the larvae of *N. patroclus* being more severe than that occasioned by the others. (The caterpillars of *N. patroclus* are of a dark orange colour, black sub-laterally and mid-dorsally with three longitudinal yellow stripes mid-dorsally (in the middle of and bounding the black area) and a yellow lateral line. They have no hairs or tubercles.) The cocoon period is 2 days, the pupal period 11—12 days. (The caterpillars of *L. achillaria* are yellowish-green in colour with blackish lateral and mid-dorsal stripes, and narrow black transverse medially interrupted lines.) The pupal period is 13—14 days. (The caterpillars of *M. astheniata* are of a pale reddish-yellow colour, faintly tinged with green, with reddish transverse stripes dorsally, and three comma-like greenish markings on the middle of each segment.) They live under the cover of a fine silken web either on the upper or lower surface of the leaves. The pupal period lasts about 8—10 days.

COLEOPTERA.

Pterolophia melanura Pasc.

This is a small brownish borer of the family Lamiidae; it has been bred from the decayed stems of the mango plant.

DIPTERA.

Chaetodacus ferrugineus Fabr.

In addition to previously recorded host-plants, this fly has been obtained from the fruits of *Eugenia aquea* ("Jambu ayer").

FIBRES.

LEPIDOPTERA.

Earias insulana Boisd.

The well-known cotton-bollworm has not yet been received in this laboratory from cotton, but was reared in 1926 from gingelly.

Lithocolletis triarcha Meyr.

The larvae of this little moth feed on the soft tissues of cotton leaves, leaving patches of clear-looking feeding-marks on the leaves, by which their presence may be detected. They pupate within brown silken cocoons, the pupal period occupying about 6 days.

INSECTICIDES.

LEPIDOPTERA.

Eucosma conciliata Meyr.

This is a microlepidopteron of the family Eucosmidae, the caterpillars of which attack the leaves of *Derris*. The caterpillars are small in size and of a green colour with a dark brown head. They pupate within two leaves held together by threads of silk. The pupal period lasts about six days.

OILS AND FATS.

HEMIPTERA.

Cerataphis lataniae Bdv.

This little Aphid is very common on the Areca palm, being found on the inflorescences and leaves of the plant.

LEPIDOPTERA.

Pyroderces ptilodelta Meyr.

The caterpillars of this small Cosmopterygid moth have been bred from the flower stalks of Areca. They cover the stalk with a mixture of silk and frass which has a moss-like appearance. Pupation takes place in a white silken cocoon usually attached on one side of a spike.

Xylinophylla maculata var. *hypocausta* Warr.

The curious caterpillars of this Geometrid moth are known to attack the leaves of *Aleurites montana*. They are about one inch long and of a dark brown colour, with two pairs of slender processes on the third and fourth abdominal segments. (Fig. 1).

Ectropis bhurmitra Walk.

Another Geometrid recorded from *Aleurites montana*. No information is available about the early stages, except that the pupal period occupies about 10 days.

COLEOPTERA.

Aulacophora coffeae Hornst.

A small yellowish-brown Gallerucid beetle found on the leaves of groundnut and sweet potato. This species is also common on pumpkin and cucumber in Malaya.

Araecerus fasciculatus De Geer.

A minute Anthribiid beetle attacking stored nuts of the *Areca* palm.

COVER CROPS.

LEPIDOPTERA.

Orgyia turbata Butler.

The caterpillars of this Lymantriid moth are known to have migrated from *Mimosa pudica* and *Centrosema plumieri* to rubber. A paper on this insect was published in M.A.J., Vol. XV, p.240.

HEMIPTERA.

Dinidor obscura Lep. & Serv.

This is a blackish bug, with a red connexivum spotted with black; it has been collected on *Centrosema plumieri*.

Nezara viridula L.

This is a common uniformly greenish Pentatomid bug; it has been taken in numbers on *Crotolaria usaramoensis*.

VEGETABLES.

LEPIDOPTERA.

Catephia leucomelas Linn.

The caterpillars of this Noctuid moth have been found attacking the leaves of sweet potato. Their general colour is

smoky black, spotted with minute more intense black spots and longitudinally striped with orange-yellow. The lateral areas bear a longitudinal white stripe. The larvae pupate in the soil, at a depth of about $\frac{1}{2}$ inch, within an earthen cell. The pupal period lasts about 12 days.

Psara submarginalis Swinh.

The larvae of this Pyralid moth are often seen on the leaves of the egg-plant or brinjal, crowded together under a silken web intermixed with leaves. When full-grown, they are about 21 mm. long and of a greenish colour with fairly large black spots above and a shiny black prothoracic shield. The pupal period occupies about 6—8 days.

Plutella sera Meyr.

The caterpillars of this microlepidopteron were found feeding on the leaves of cauliflower.

HEMIPTERA.

Anoplocnemis phasiana Fabr.

This is a large brownish Coreid bug nearly 30 mm. long, with the apices of the wings dull black and the posterior femora greatly swollen and conspicuously toothed. The eggs are laid in a line, resembling a bead necklace. The incubation period lasts for about 10 days, the first nymphal instar for about 5 days. Attempts to rear the nymphs to maturity under laboratory conditions were not successful. Both adults and nymphs suck the sap from the shoots of the egg-plant.

Acanthocoris scabrator Fabr.

Generally speaking this bug is rather similar to the one discussed above, but is considerably smaller (about 12 mm. long). It has been found sucking the young shoots of the sweet potato.

Physomerus grossipes Fabr.

This is another Coreid found on the sweet potato, sucking the stems and young shoots. It is a long (about 19 mm.) narrow species, of a reddish-brown colour with the membranous part of the wings smoky black. The thorax is medially longitudinally striped with pale red. There are five nymphal instars before maturity is reached, the first instar occupying about 5 days, the second 9 days, the third 11 days, the fourth 9 days, the fifth 19 days. The total life-cycle, excepting the incubation period, therefore occupies about 53 days.

DIPTERA.

Chaetodacus cucurbitae Coq., & *Chaetodacus caudatus* Fabr.

These two fruit-flies were reared in 1926 on pumpkin. The life-history has been found to be similar to that of *C. ferrugineus* F. in Malaya. The eggs of *C. cucurbitae* are inserted at wide intervals in the fruit, and are of a white colour and oblong shape. The total life-cycle occupies from 10—15 days, generally 12—13, the incubation period apparently never lasting more than a day, and the larval period 4—5 days. The pupal period varies from 7—10 days, but is usually 8 days. The eggs of *C. caudatus* are laid in masses of about 28 eggs in the fruit. Laboratory records concerning this insect are not exhaustive, but show that the total-life cycle is completed in about 12 days. Like *C. ferrugineus*, both these species pupate in the soil. The presence of eggs in the fruit is more or less easily detected by the punctures caused by the ovipositor of the female in depositing her eggs under the skin of the fruit. Covering the fruit has been resorted to by small cultivators, with successful results. Fruit flies are of considerable economic importance in Malaya and require to be systematically investigated.

RICE.

HEMIPTERA.

Leptocorisa spp.

A bulletin on these insects is in course of preparation.

Leptocorisa acuta is the species mostly concerned in the damage done to rice.

Sogata pallescens Dist.

The damage done by this small insect has already been discussed in "Miscellaneous Insects of 1925". Where irrigation was practised, small quantities of kerosene oil poured into the water and a rope dragged across the padi so as to get the insects in contact with the film of oil was found to be an effective means of control. In Province Wellesley, where the majority of the rice-fields are not irrigated, it was suggested that a sheet of tin or other suitable material in the form of a funnel smeared with some sticky substance should be placed around each padi-plant, the plant being

shaken. Although laborious, this was found to be an effective method of control.

More recent investigations indicate that this pest attacks plants growing in stagnant and somewhat acid water. In Krian running off the water from the padi-fields and re-flooding after a couple of days was found to be successful.

Nilaparavata sordescens Motsch.

This Fulgorid is rather similar to *Sogata pallescens*, and was associated with it in the outbreak on rice. It is interesting to note that *N. sordescens* is definitely attracted to light, while according to Misra (Bull. No. 104, Agric. Res. Institute, Pusa, p.435, 1921) *S. pallescens* is negatively phototropic. These statements were supported by recent investigations in Krian. Further work on the tropisms of these insects would be important, as light-traps and fires have been extensively employed in the control of other leaf-hoppers, such as the Jassid, *Nephotettix bipunctatus* F.

Nephotettix bipunctatus F.

This is a small green insect with the apices of the wings black, the male having in addition a black spot about the middle of each wing. *N. bipunctatus* is not common here, but was reported causing damage to padi in 1926 in the Malacca area, and was associated with *Sogata pallescens* in the outbreak in the Krian district.

RUBBER.

LEPIDOPTERA.

Cyana ridleyi Hamps.

This is a whitish Arctiid moth with longitudinal orange markings on the wings, occasionally seen on rubber estates. The larva pupates within a cage-like cocoon composed of black hairs, within which the pupa lies suspended by an almost invisible thread on the anterior and posterior ends of the body respectively, which is attached to the top of the cocoon. The peculiar appearance of the pupa and its "cage" is shown in the accompanying drawing (Fig.2). One of these pupae was received in the Entomological laboratory from the stem of a para rubber tree.



Fig. 1. Caterpillar of *Xylinophylla maculata*
var. *hypocausta* Warr.



Fig. 2. Pupa of *Cyana ridleyi* Hampson.

ORNAMENTAL AND MISCELLANEOUS PLANTS.

LEPIDOPTERA.

Catopsilia crocale var. *catilla* Cram.

The greenish caterpillars of this Pierid butterfly attack the leaves of *Cassia fistula*, and appear to be more injurious to those exposed to sunlight. The pupal period lasts about 5-7 days.

Parasa lepida Hamps.

This Limacodid moth has been found attacking the leaves of nipah, sword-bean, and china-wood oil. The caterpillars are of a bluish or greenish colour with lateral processes bearing bunches of hairs. In the earlier stages these processes are distinctly spiny, those on the anterior and posterior extremities of the body being longer. The full-grown caterpillar is whitish with a pink tinge. It pupates in a compact oval cocoon. The pupal period is apparently very long, two specimens on *Aleurites* taking 53 and 63 days respectively to emerge. In Province Wellesley, where it occurred on the sword-bean, handpicking was found to be sufficient for its control. Spraying with lead arsenate (3 lbs. to 50 gallons of water) has been found to be necessary for the control of this insect on the nipah palm.

Altha albiguttatus Snell.

The smooth, bluish-green caterpillars of this Limacodid attack the leaves of the Cape jasmine. They pupate between two leaves in a round white cocoon, enclosed by a thin silk web. The pupal period occupies about 21 days.

Parnara cahira Moore.

The caterpillars of this skipper attack the shoots of bamboos. They are greyish-green in colour with a grey head banded with black. They live within the rolled bamboo shoots and pupate inside them. The pupal period lasts about 9 days.

COLEOPTERA.

Strongylium erythrocephalum F.

This is an elongate metallic bluish-green Tenebrionid beetle which was obtained from the wood of imported boxes.

HOUSEHOLD PESTS.

HEMIPTERA.

Enquiries regarding the eradication of bed-bugs, probably *Cimex rotundatus* Sign., which inhabit rattan furniture, bed-boards and similar places were received.

The following solution has proved effective in controlling them.

Tuba root	...	...	1 lb.
Soap	...	...	1½ lbs.
Water	...	...	10 gallons.

LEPIDOPTERA.

Carpet and Clothes-Moths.

Two species of Tineidae are so far known to be incriminated in the damage done to clothes, furs, carpets and similar materials in Malaya. These are *Tinea despecta* Meyr. and *Trichophaga abruptella* Woll., the last species being hitherto unrecorded in Malaya. *T. abruptella* seems to be the species usually found on carpets and upholstery in this country. Fumigation with carbon bisulphide has proved to be a successful control. Ordinary preventive measures, such as the use of moth-balls, naphthalene and similar substances are well-known and need not be described here.

THYSANURA.

Fish-insects.

The silver-fish (*Lepisma* sp.) sometimes does considerable damage to books in Malaya. Books may be protected by painting with a solution of half-an-ounce of corrosive sublimate and carbolic acid respectively in one pint of methylated spirit. Books in open book-cases (*i.e.* the doors of which are covered with wire-netting and not glass) are less liable to attack.

PREDACEOUS AND PARASITIC INSECTS.

COLEOPTERA.

Coccinellidae.

Coccinella 8—*maculata* F., *Coccinella transversalis* F.,
Chilomenes 6—*maculata* F., and *Chilocoris politus* Muls.

These four Coccinellids are all predaceous on various Aphids, *Chilocoris politus* Muls. having been found feeding also on the Coccid *Ceroplastodes virescens* Guen.

RHYNCHOTA.

Reduviidae.

Sycamus leucomesus Walker. On the Pentatomid, *Nezara viridula* L.

Euagoras plagiatus Burm. and *Euagoras sordidatus* Stal.

These two species are probably predaceous on *Leptocorisa* sp. in the field, *Euagoras sordidatus* having been found in the laboratory to attack *Leptocorisa acuta* Thunb.

Cosmolestes picticēps Stal. This species has been found attacking the caterpillars of the Pyralid *Psara submarginalis* Swinhoe and of the Noctuid, *Heliothis flavigera* Hampson, both these moths being pests of tobacco.

DIPTERA.

Syrphidae.

Ischiodon scutellare F., *Paragus serratus* F. and *Asarcina aegrota* F.

These three species are common predators of various Aphids, *Ischiodon scutellare* being associated with (?) *Aphis rumicis* L., and *Asarcina aegrota* with an unidentified Aphid on coconuts. *Paragus serratus* was found feeding on *Aphis gossypii* Glov. on chilly.

Sarcophagidae.

Sarcophaga orientaloides Senior-White. Specimens have been obtained which emerged from pupae of *Hidari irava* Moore.

Tachinidae.

Winthemia semiberbis Bezzi. On caterpillars of the Noctuid paddy stem-borer, *Sesamia inferens* Walk.

Blepharipoda ophirica Walk. On caterpillars of the Noctuid, *Tiracola plagiata* Walk.

Halidaya luteicornis Walk. and *Halidaya rufa* Bezzi. Both these Tachinids are parasitic on the rice-leaf skipper, *Larnara mathias* F.

Podomyia setosa Dol. On the caterpillars of the Noctuid, *Prodenia litura* F.

Exorista laeviventris v.d. Wulp. On the Geometrid, *Hemithea costipunctata* Moore.

Exorista cervinoides var. *rufella* Bezzi. On the Limacodid, *Chalcoscelis fumifera* Swinhoe.

Hemimaticera basifulva Bezzi. The principal recorded parasite of the coconut spike moth *Tirathaba* (sp. nr. *trichogramma* Meyr.) (Pyralidae). *rufivena* Walk.

Carcelia modicella v.d. Wulp. On caterpillars of *Orgyia cerigoides* Walker and other Lymantriids.

Sturmia atropivora R.D. On various Sphingid larvae.

Sturmia inconspicua Mg. On the Noctuid, *Tiracola plagiata* Walk.

Sturmia parachrysops Bezzi. On the Pyralid, *Psara bipunctalis* F.

Chaetexorista javana B.B. On the Limacodid, *Setora nitens* Walk.

Tricholyga aberrans Strobl and *Tricholyga sorbillans* Wied.

These two species are parasitic on the caterpillars of the butterfly *Amathusia phidippus* L., *Tricholyga sorbillans* also parasitising various Sphingid and Psychid caterpillars and the Lymantriid, *Orgyia postica* Walk.

HYMENOPTERA.

Chalcididae.

Chalcis marginata Cam. On caterpillars of *Amathusia phidippus* L.

Ichneumonidae.

Henicospilus flavocephalus Kirby. On larvae of the Lymantriid, *Nygmia scintillans* Walk.

Braconidae.

Apanteles creatonoti Vier. From a semilooper collected on castor.

Pristocelus fumipennis Wilkinson. On caterpillars of the Pyralids, *Lamprosema diemenalis* Guen. and *Pycnarmon cribrata* F.

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Plant Importation Rules—1925.

NOTICE TO IMPORTERS OF PLANTS.

No plant whatever coming from a foreign country may enter the Colony of the Straits Settlements or the Federated Malay States except through one of the three Entry Ports, Singapore, Penang or Port Swettenham. This does not apply to plants shipped from one part to another in Malaya.

Plants of Para Rubber, Cotton, Sugar Cane, Coffee, Seed nuts of Coconuts, Living and Growing Palms and Suckers of Bananas from a foreign country may only be imported into Malaya through an Entry Port after full compliance is made with the instructions laid down in the Plant Importation Rules of 1925, namely that the importer should apply to the Secretary for Agriculture for a permit to import, in one or more consignments, a supply of any such plants.

Application for the Permit should be made before arrangements are made for the consignment to be despatched from the country of origin, whilst granting of the permit is dependent upon the condition that each consignment is accompanied by a certificate of freedom from pests, signed by a properly qualified person, previously approved by the Secretary for Agriculture, in the country of origin.

Further information can be obtained from the Secretary for Agriculture or the Chief Field Officer.
